PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Article 36 and Rule 70)

Applicant's or agent's file reference CH920010059	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)

International application No. PCT/IB 03/02409	International filing date *(day/month/year)* 20.06.2003	Priority date *(day/month/year)* 24.06.2002

International Patent Classification (IPC) or both national classification and IPC
H04L29/06

Applicant
INTERNATIONAL BUSINESS MACHINES CORPORATION et al

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:

   I   ☒   Basis of the opinion

   II   ☐   Priority

   III   ☐   Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

   IV   ☐   Lack of unity of invention

   V   ☒   Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

   VI   ☐   Certain documents cited

   VII   ☐   Certain defects in the international application

   VIII   ☐   Certain observations on the international application

Date of submission of the demand 04.12.2003	Date of completion of this report 06.09.2004
Name and mailing address of the International preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Oteo Mayayo, C Telephone No. +49 89 2399-7563

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-12   as originally filed

Claims, Numbers

1-13   filed with telefax on 24.06.2004

Drawings, Sheets

1/5-5/5   as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description,   pages:

   ☐ the claims,   Nos.:

   ☐ the drawings,   sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-13
	No:	Claims	

Inventive step (IS)	Yes:	Claims	1-13
	No:	Claims	

Industrial applicability (IA)	Yes:	Claims	1-13
	No:	Claims	

2. Citations and explanations

see separate sheet

1.   **Concerning Item V**
Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1.1   The present invention relates to a **method** of load balancing in a data communications network and to a corresponding load balancing **apparatus** according to independent **claims 12 and 1,** respectively.

The document cited in the International Search Report and considered as the closest prior art (D1: **EP 1 130 849 A2, FUJITSU LIMITED, 05.09.2001**), discloses a method for distributing load in a plurality of routes from one communication apparatus to another, by adding or deleting transmission paths from a traffic characteristic collection section, and afterwards equalizing the load among the transmission paths.

The problem solved by the present invention is regarded as how to distribute incoming packets among network entities not used until the moment, by using a hash function. The solution to said problem is that the redefinition of parameters of the hash function from a first set to a second set is triggered, in order to redistribute the data packets among the network entities not yet used (i.e. downstream objects).

The method according to claim 12 differs from that of D1 in that in D1 it is disclosed the use of a hash function for every incoming data packet, every time a new set of permitted transmission paths can be used. Therefore, and contrary to the invention, in D1 the hash function itself is not changed (i.e. its parameters), but the same hash function is applied to a certain part of each incoming data packet, modifying the packet, every time a new set of transmission paths is added. Therefore, the invention provides an alternative solution to the problem of how to distribute packets among network entities (i.e. downstream objects) by using a hash function.

Therefore, the skilled person would not be prompted to derive a method according to independent **claim 12** or a system according to independent **claim 1** from D1. Thus, claims 1 and 12 are considered to be **new** and to **involve an inventive step**, Articles 33 (2) and (3) PCT.

As **claims 2 to 11 and 13** are dependent on claims 1 and 12, respectively, said claims 2 to 11 and 13 do also meet the requirements of Article 33 (2) and (3) PCT.

The present invention is **susceptible of industrial application**, Article 33 (4) PCT.

1.2   Each independent claim should have been drafted in the proper two-part "characterised" form recommended by Rule 6 PCT, having a preamble that correctly reflects the nearest prior art, presumably that represented by document D1.

The opening part of the description should have been brought into conformity with the wording of the claim of broadest scope as finally amended.

All the claims should have included reference signs in parentheses where features shown in the drawings are referred to (Rule 6.2 (b) PCT).

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CLAIMS

1.   Load balancing apparatus for a data communications network, the apparatus comprising:

hash logic for computing a hash function on incoming data packets;

a threshold detector connected to the hash logic for triggering, in response to utilization of downstream objects exceeding a predefined threshold, redefinition in the hash logic of parameters of the hash function from a first set of parameters to a second set of parameters for redistributing the data packets amongst the downstream objects; wherein,

the hash logic, in use, has means for directing the packets for routing to downstream objects in the network via a first routing path based on a hash computation using the first set of parameters, and, if the threshold is exceeded, for selectively directing the packets to one of the first routing path and a second routing path in dependence on separate hash computations using the first and the second sets of parameters for subsequent routing of the packets via the selected one of the first and second routing paths based on the results of one of the separate hash computations.

2.   Apparatus as claimed in claim 1, wherein the hash logic in use has means for directing the data packet to the first routing path if the results of the separate hash computations coincide and otherwise means for directing the data packet to the second routing path.

3.   Apparatus as claimed in claim 1 or claim 2, further comprising a filter connected to the hash logic for

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selectively bypassing the hash logic for flows having a lifetime exceeding a predefined value.

4.   Apparatus as claimed in claim 1, further comprising the first routing path and the second routing path, the first routing path comprising first routing logic connected to the hash logic, and the second routing path comprising second routing logic connected to the hash logic, wherein the first routing path is faster than the second routing path, and wherein, on the second routing path, downstream objects are selected based on packet flow status.

5.   Apparatus as claimed in claim 4, wherein the first routing logic comprises at least one network processor and the second routing logic comprises at least one general purpose processor.

6.   Apparatus as claimed in claim 4 or claim 5, wherein the second routing logic is configured to detect a flow delimiter in a flow of data packets and, on detection of the start indicator, to route the corresponding flow according to the hash function using the second set of parameters.

7.   Apparatus as claimed in claim 6, wherein the second routing logic is configured to detect flows of packets exceeding a predetermined inactivity time and to route such flows according to the hash function using the second set of parameters.

8.   Apparatus as claimed in claim 7, wherein the second routing logic is configured to detect flows of packets exceeding a predetermined lifetime and to direct such flows to the first routing logic.

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9.   An application specific integrated circuit comprising a load balancing apparatus as claimed in any preceding claim.

10.   A network infrastructure node comprising a load balancing apparatus as claimed in any of claims 1 to 7.

11.   A data communications network comprising a network infrastructure node as claimed in claim 10.

12.   A method of load balancing in a data communications network, the method comprising:

computing a hash function on incoming data packets;

triggering, in response to utilization of downstream objects exceeding a predefined threshold, redefinition of parameters of the hash function from a first set of parameters to a second set of parameters for redistributing the data packets amongst the downstream objects; and,

directing the packets for routing to downstream objects in the network via a first routing path based on a hash computation using the first set of parameters, and, if the threshold is exceeded, selectively directing the packets to one of the first routing path and a second routing path in dependence on separate hash computations using the first and the second sets of parameters for subsequent routing of the packets via the selected one of the first and second routing paths based on the results of one of the separate hash computations.

13.   A method as claimed in claim 12, comprising directing the data packets to the first routing path if the results of separate hash computations coincide and otherwise directing the data packets to the second routing path.